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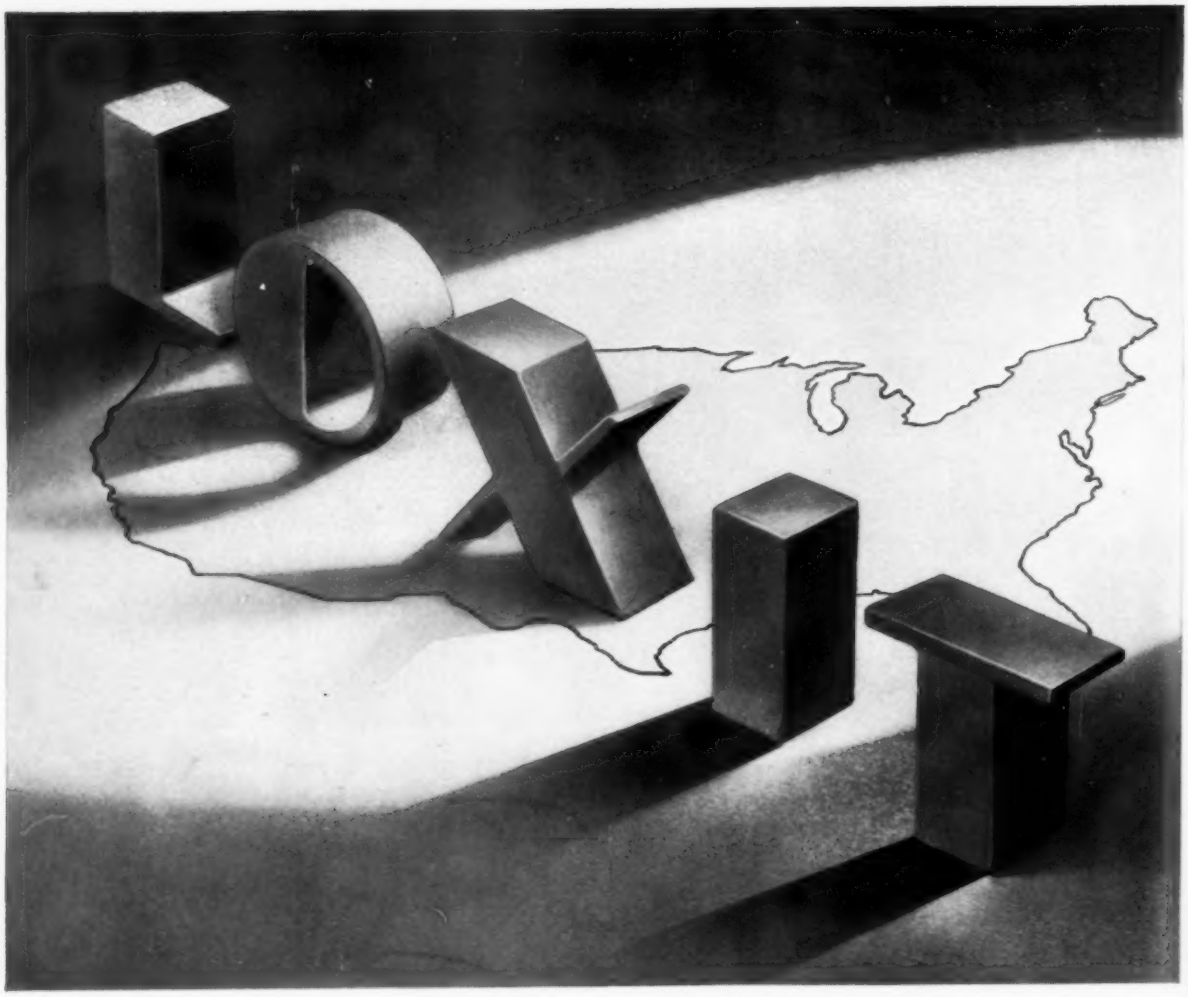

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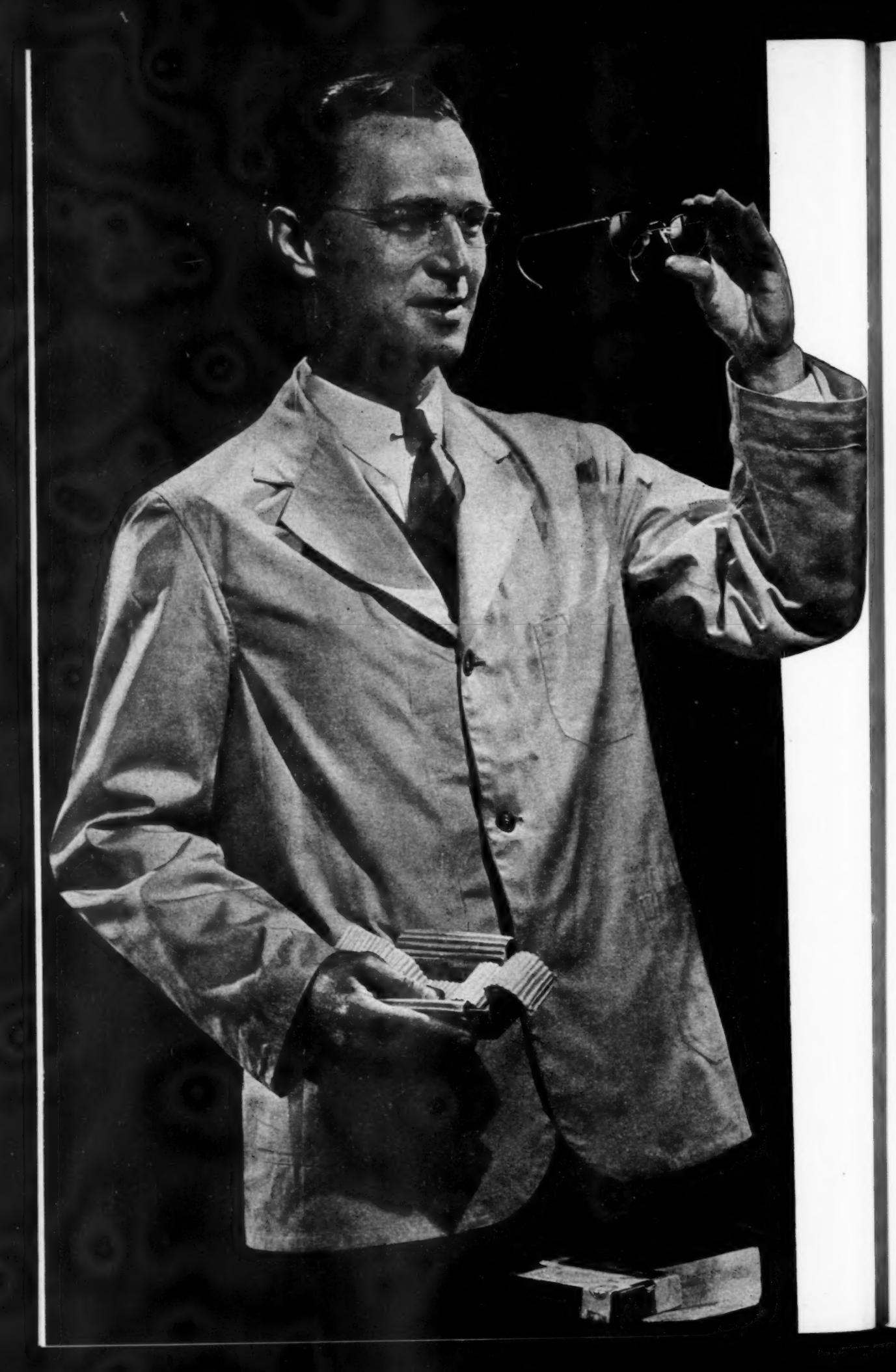

AMERICAN JOURNAL OF OPTOMETRY

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A NEW TECHNIQUE IN CORRECTING REFRACTION OF APHAKIC EYES*

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It may not be amiss to call the attention of the scientific reader at the very outset, that while some of the principles cited are hardly new, the technique per se—as applied here presents a rather original approach to a practical problem in the realm of Optics, i.e., a method of correcting the refraction of an aphakic eye based on the efficacy of lenses when held before the eye at varied intervals.

The subjective method in vogue in prescribing lenses for aphakic eyes after the patient has been retinoscoped, is the insertion of a weaker lens than is observed objectively and then modifying same as may appear necessary. The lenses usually required in these cases range in power from +7 diopters to +15 diopters, depending on how extensive an error the patient had prior to the removal of the Crystalline Lens. After the error has been approximately corrected, including the astigmatism nearly always present after a lens extraction, the examiner adds plus or minus spheres until he reaches a correction to be prescribed. Usually plus or minus 0.25 spheres produce a difference of too slight a degree for the patient to distinguish.

The patient after being questioned a little too long becomes confused, and sometimes a bit nervous and fidgety, and after a while cannot even answer the examiner's question at all. He begins to feel that the entire method is one involving a lot of guesswork, due to trial and error procedure. A difficulty faced by this method is one where after the finished lenses are placed in front of the eyes, it is very probable that they will not focus accurately the image on the retina. This is due to the fact that the position of lenses in the trial frame might have been further or nearer than the finished glasses, or the lenses may have been made up in a different form than the trial case lenses, without having made allowance for the effective power. In non-aphakic cases with low errors of refraction this difficulty is greatly minimized.

Before going into details of our new technique, it will be advisable to review briefly some basic principles on which our procedure hinges.

*Submitted for publication Dec. 9, 1935.

In recent years much has been heard about effective power of a lens. By effective power we mean, "the power so measured that the Rx lens if properly placed before the eye, gives the same effect on the eye as the test lens."

In lenses of high power, such as +7 spheres or more, effectivity is an important factor. To illustrate, let us take a lens which brings light to a focus at F′ (Fig. 1). We take a point M between F′ and A, on which the rays do not come to a sharp focus. If the lens were stronger and had a shorter focal length the rays would come to a focus at M. However, the same can be accomplished by simply moving the lens away until F′ falls on M. In other words, by withdrawing the lens, the same effect is produced as by actually increasing the power of the lens. We may say then, that the effectivity of the lens was increased with respect to point M. To what degree was this lens increased in power with respect to point M? If the focal length of the lens was +10 diopters effective power, it implies that the back focal length AF′, was 10 cms. Presuming that the point M was situated 2 cms. from F′, we could then say that if the lens were of a focal length of 8 cms., then M would have been in focus; or else moving back the lens of 10 cms. focal length, 2 cms. to A, produces a similar effect as though it were a lens with a focal length of 8 cms., or + 12.5 diopters. From this we can readily see that a lens is more or less effective in bringing light to a focus at a definite distance from a fixed point, according to its position with respect to that point.

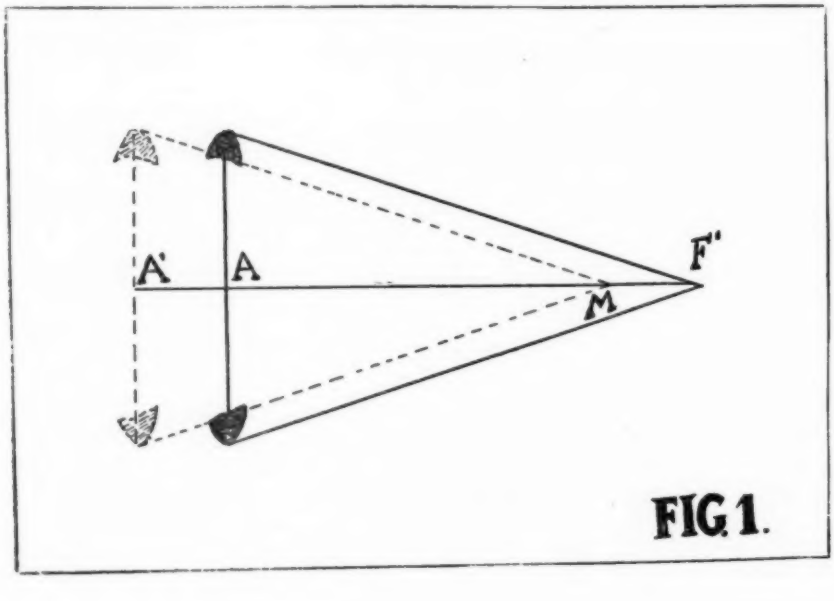

FIG 1.

With this scientific principle as the basis, a table was computed to show the effective power of the lenses to be used in our new technique, at intervals ranging from one to twenty millimeters away from the anterior focal plane or the plane of unit magnification of non-aphakic eyes. This plane existing at about 14 millimeters from the cornea, was used as the foundation for computing the table.*

It is also well known that lenses ground to effective power will have their correcting effect, *only* when worn at this universally accepted distance from the cornea. When worn at a remote or closer distance, the effectivity of the lens is either increased or decreased if the lens in question is one of convex power.

The method used in computing the table is rather simple. Using the formula F=1/f where F is the power of the lens in diopters, and f the focal length expressed in meters, we find that a lens of +9.25 diopters effective power, will have a back focal length of .1081 meters. Should we, however, move this lens 8 millimeters or .008 meters further out from its original position, this lens will have the effectivity of one having a focal length of .1081 meters, minus .008 meters or .1001 meters. F will then be found to be equal to 1/.1001 or +9.99 diopters, which we may call for our purposes +10 diopters.

In other words we may say that a lens of +9.25 diopters effective power, when placed at 8 millimeters from our adopted 14 millimeter plane in front of an eye, will have an effective power of +10 diopters. In this same manner the effective powers of five different lenses to be used in this technique, were computed for different distances from one to twenty millimeters out.

In order that a spectacle lens be a correction glass, it is an essential requirement that its second focal point F', should coincide with R, the farpoint of an eye. In Fig. 2a is shown an aphakic eye, with its far point situated at R. It is partially corrected with a +9.25 diopter lens which still leaves the eye hyperopic to the extent of three-quarters of a diopter. Fig. 2b is intended to show that by moving the +9.25 diopter lens 8 millimeters further out in front of the same eye, F' will then coincide with R, making the lens at that distance a correction glass. Fig. 2c shows the condition corrected with an equivalent lens of +10 diopters effective power, placed at the regular 14 millimeter distance from the cornea. The second focal point of the lens, F', coincides with R, thus also meeting the required condition for a lens to be a correction glass.

To utilize now this idea in a new technique which would eliminate the use of many lenses in subjective testing, all that will be necessary is to know the effective power of the several lenses to be used at different distances in front of an eye. The accompanying table accurately gives us

*In an aphakic eye, the anterior focal plane is situated at about 20 millimeters from the cornea. The corrected aphakic eye sees an object about 30% larger than an emmetrope.

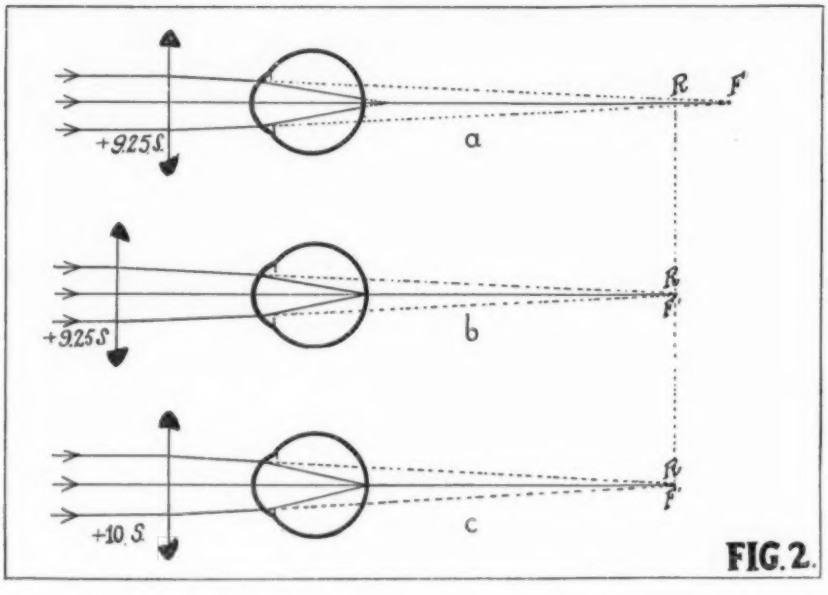

FIG. 2.

such values for 5 of the necessary lenses, with which to fit any aphakic eye whose refractive error is between 7 diopters and 16.66 diopters of hyperopia. In cases where our table shows us that the equivalent effective power is, e.g., +16.66 diopters, the lens to be ground up should be nearest to that, to the one-eighth of a diopter which in this case would be a lens of +16.62 diopters.

Applying this principle of effectivity of lenses to ocular refraction, the writer feels that a new technique is possible in aphakic cases, which has many advantages over methods heretofore used.

The basic requirements are simple and few. All that will be necessary will be five trial lenses consisting of +7, +8, +9.25, +10.75 and +12.50 diopter spheres, ground to effective power. In addition we will need cylinders, ranging in power from +0.50 to +3.50 diopters. The next requirement is a special trial frame with two cells. The first cell (when the frame is adjusted) should set at 14 millimeters in front of the cornea and be so constructed that it is fixed and not movable. The 14 millimeter distance can be easily obtained by means of an aligning mark on the temples. This cell will contain during our test the cylinder for the correction of the astigmatism. The second cell for the correcting sphere should be so arranged that by the turning of a knob it can be moved forward and outside of our original starting position and then also backward. An accompanying fixed scale calibrated in millimeters which would enable us to know at all times exactly how far the sphere is from our original fixed position of 14 millimeters, is a pre-requisite,

so that the examiner will be enabled to record the effective power of the lens used from the accompanying table of effective powers.

Method of Procedure

Upon completion of all preliminary objective tests we determine e.g., that the case on hand should get best visual acuity with a correction amounting to approximately +10 D.S.⊃+2 D.C. x 180. It might turn out, however, to be +10.25, +10.50 or +10.75 D.S.⊃+2. D.C. x 180. Our aim is to accurately determine the exact correction subjectively. A careful adjustment of the trial frame both as to the proper angle as well as to the proper distance from the cornea is made. The latter may be easily accomplished by ascertaining that the aligning mark on the temples be in line with the plane of the cornea. The correcting cylinder then inserted would be 14 millimeters from the cornea. The axis of the cylinder should be set as near as possible to its proper position. The finer adjustments will come later after the correcting sphere has been determined. We then insert a +9.25 diopter sphere in the outer cell, asking the patient to read the visual acuity chart at twenty feet. When the maximum vision is noted we then proceed to turn the little knob controlling the forward movement of the cell in which our spherical test lens is. We turn very slowly and note the patient's reaction. If our prior determination of +10 diopter sphere is correct we will find that as the lens is slowly moved forward, the patient will respond with "There, that's better," or some similar remark. The further we remove the lens, the greater is the improvement to be noticed by the patient, until we reach a point 8 millimeters out where best vision will be noted. We then go back to the cylindrical element and make a finer adjustment of the axis. If we definitely decide that 180 degrees is the most accurate axis, we revert again to our spherical element and make several attempts at determining the exact position of the patient's clarity of vision.

It is very advisable to move the sphere several times both outside and inside the clearest position and note the point at which the patient feels that vision is best. This should be found nearest to 8 millimeters on the calibrated scale. By referring to the table on page 6 which everyone should have in enlarged form for convenience sake, we find that the effective power of +9.25 diopter sphere at 8 millimeters is exactly +10 diopters. We may then most assuredly prescribe +10. D.S. ⊃+2.00 x 180, effective power, and feel that results will be most gratifying.

The procedure in determining the distant correction can not be applied to the near test. "For *parallel light* the effectivity of a convex lens is always increased as the lens is farther out from the eye, and such changes are proportional to the power of the lens and the departure from the normal position.

"When light is *divergent*, however, the changes are different. With a convex lens the effectivity for a near object increases as the lens is

TABLE OF EFFECTIVE POWERS

Note: Add 14 millimeters to distances in top line to get net distance of lens in front of eye.

	1 mm.	2 mms.	3 mms.	4 mms.	5 mms.	6 mms.	7 mms.	8 mms.	9 mms.	10 mms.	11 mms.	12 mms.	13 mms.	14 mms.	15 mms.	16 mms.	17 mms.	18 mms.	19 mms.	20 mms.
+ 7.00	+ 7.05	+ 7.10	+ 7.15	+ 7.21	+ 7.26	+ 7.31	+ 7.36	+ 7.42	+ 7.47	+ 7.53	+ 7.59	+ 7.64	+ 7.70	+ 7.76	+ 7.82	+ 7.88	+ 7.95	+ 8.01	+ 8.08	+ 8.14
+ 8.00	+ 8.06	+ 8.13	+ 8.19	+ 8.26	+ 8.33	+ 8.40	+ 8.47	+ 8.54	+ 8.62	+ 8.69	+ 8.77	+ 8.85	+ 8.92	+ 9.00	+ 9.09	+ 9.17	+ 9.26	+ 9.34	+ 9.43	+ 9.52
+ 9.25	+ 9.34	+ 9.43	+ 9.52	+ 9.61	+ 9.71	+ 9.80	+ 9.90	+ 10.00	+ 10.10	+ 10.21	+ 10.31	+ 10.41	+ 10.52	+ 10.64	+ 10.75	+ 10.87	+ 10.99	+ 11.11	+ 11.23	+ 11.36
+ 10.75	+ 10.87	+ 10.99	+ 11.11	+ 11.23	+ 11.36	+ 11.49	+ 11.63	+ 11.76	+ 11.90	+ 12.05	+ 12.19	+ 12.34	+ 12.50	+ 12.66	+ 12.82	+ 12.98	+ 13.16	+ 13.33	+ 13.51	+ 13.70
+ 12.50	+ 12.66	+ 12.82	+ 12.98	+ 13.16	+ 13.33	+ 13.51	+ 13.70	+ 13.89	+ 14.08	+ 14.28	+ 14.49	+ 14.70	+ 14.92	+ 15.15	+ 15.38	+ 15.62	+ 15.87	+ 16.13	+ 16.39	+ 16.66

carried outwards, but not to so great an extent as when the object is distant, and the *lessened increase* of effect is *greater* as the point of view is nearer, the increase altogether ceasing when the object viewed is in front of the lens at a distance equal to twice its focal distance. If the distance of the object beyond the lens is less than 2f, a further approach of the lens towards the object and away from the eye, results in a diminishing effectivity. The latter then becomes less and less as the lens approaches the object, and is zero when the two are in contact."

Thus it is very apparent that it is hopeless to try to determine the Rx for close work by this new method. However, as most cases seldom require more than the usual addition of +3 diopter sphere, the latter can be given most unhesitatingly. Where vision is much below standard +3.50 diopter sphere can then be prescribed. Another solution where two pairs of glasses are prescribed, which is usually the case, would be to make up the distant pair first and then test for the reading addition with fit-overs consisting of +3, +3.50, and +4 diopter spheres.

An important factor which must be taken into consideration is the *size of the retinal image*. We must not forget that a lens of a certain effective power when placed at a farther distance from the eye than one of an equivalent effective power at a closer distance, will produce a retinal image that is larger in size. Thus, during our test we may obtain better vision than with the finished Rx lens, as the testing lens at its farther distance will also serve slightly as a magnifying lens. Off-hand it might appear that this would be a great disadvantage. Upon deliberation, however, it will be seen that this factor does not affect our ultimate results. The better vision found during the examination, and this will not occur in all cases, may easily be accounted for, if necessary.

It will be possible with the better vision obtainable, due to the magnification, to aid patients to more easily determine the exact axis of the correcting cylinder, in addition to the clearest position of the correcting sphere. It is possible that the resultant visual acuity with the finished Rx lens will not be as good as during the examination. Nevertheless, the lens found by our method will be one that should focus the image sharply on the retina—and that is our prime purpose. The patient should be instructed to look for sharpness of image rather than magnification.

While on the subject of magnification, it appears to the writer that sub-normal vision in aphakic cases can be brought up by giving them the advantage of the better vision disclosed sometimes during the examination. This can be done very simply by prescribing lenses of weaker power, set in a frame so constructed as to have the lenses extend farther out than the usual distance. This new technique could then be utilized very effectively for that purpose. Of course, this should only apply to cases that are definitely lacking in useful vision.

Summary

In summing up it would be in place to enumerate some of the advantages of our new procedure.

(1) Until now, no attempt has been made to correct aphakic eyes to an eighth of a diopter, nor even possibly to a quarter of a diopter, as the difference between such small amounts could not be discerned by the patient. I dare say that some patients cannot even differentiate changes produced by one-half diopter lenses. This may be due to poor interpretative ability or a difficulty in being able to retain a vivid mental impression of images produced by comparative lenses. By this *new gradually-focusing technique,* the process of retaining or interpreting impressions is much simpler. It becomes very much similar to focusing a pair of opera glasses, an experience which every one has had at one time or another. The range of clear focus is so small that the percentage of possible error is very much diminished.

(2) The entire subjective test can be made in much less time. It eliminates from the patient's mind the impression which inevitably is created, that subjective testing is purely guesswork on the part of the examiner and entirely dependent on the patient's answers.

(3) No lenses are inserted outside of the original one, (excluding cylinders) except when we have underestimated the error, and no confusing questions are asked.

(4) In order to get satisfactory results it is essential that the distance at which the finished glasses will set in front of the eyes be carefully measured. The same applies to any method that one may use. In the latter case, however, the tendency is to just approximate, and sometimes a difference of two or three millimeters will cause a change of as much as three-quarters of a diopter, as can be seen from the table on page 6. Where *precision* is the supreme desideratum, *accuracy* is sure to develop, and with *it,* most encouraging results will be obtained.

In conclusion I might say that whereas until now aphakic eyes were refracted in a more or less perfunctory manner, it is now possible by this new technique, to get results of almost unerring precision.

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FUNCTIONAL DISTURBANCES OF THE EYES*

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After reading a large number of textbooks on ocular disease, I have noticed a tendency to omit any discussion of functional disturbances in the sense that I desire to discuss them in this paper. Amblyopia is functional, but I intend for the moment to consider the term to apply to those cases wherein there are local ocular symptoms without pathological signs, and yet the correction of refraction and muscular errors does not entirely give relief, and sometimes no relief at all.

We know that embolism of the central retinal artery will cause complete blindness in the affected eye; on the other hand, we are also familiar with typical healthy fundi in young people; in these cases the fundus picture glistens with health and has a distinctive beautiful appearance. Between these extremes many degrees of varying retinal health must exist, and yet there are no precise clinical signs until the extreme is met with as in embolism or cases wherein exudate, haemorrhages, arterial sclerosis or optic neuritis exists. The same occurs in the anterior segment of eye. In youth the pearly whiteness and absence of vessels is distinctive, while, on the other hand, older persons often have dilated vessels without cyclitis, conjunctivitis and other diseases being present.

The question of pathology is a well-worn and futile argument against the practice of optometry, and is based upon the amount of local pathology witnessed at an ophthalmic hospital wherein these cases naturally segregate. In private practice local pathology beyond conjunctivitis and abnormalities of the ocular appendages is not frequently encountered, especially now that the population is attending to the preservation of eyesight through hygiene and correct spectacles, for is it not obvious that the department of ocular disease is, except for certain conditions, the end result of ocular neglect? Moreover, is it not natural that the textbooks of the past should be concerned to the extent of 90% in pathology while only 10% of their pages were devoted to prophylaxis in the aspect of refraction, phorometry and ocular hygiene? It is to be regretted that many modern textbooks on ophthalmology are based upon the old times, and one is just a copy of the other with minor variations.

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*Submitted for publication Nov. 1, 1935.

Through experience we learn that many ocular symptoms, after pathology has been ruled out, are not relieved through correction of refraction and muscular errors; attention to the defects only gives a measure of relief; it is in these cases that the study of history and symptoms (particularly the former) becomes imperative.

Some may be inclined to maintain that this requires a great deal of time, but with knowledge and experience the information can be obtained very quickly. General conditions can affect the functioning of a pair of eyes without causing local pathology, the disorder lies in the effect upon the blood stream and the nerve cells and fibres, hence the function of the retinae and the optic nerves, which convey this sensation to the brain, is disturbed, and symptoms of an entoptic nature in the seeing of light flashes, phosphenes, and persisting retinal images are sometimes met with. The vision tires quickly. A second functioning depends upon muscular movement, and here certain types of twitchings are sometimes complained of, and, thirdly, the ocular protection in the sensory nerves can cause various types of pain to occur. The symptoms are variable and are not easily explained; they are not like the typical asthenopic frontal headache which is experienced as close work is persisted with. In some instances slight obscurations of vision and night blindness are complained of, the latter when the liver is affected. In some cases the spectacle bridge and sides are apt to cause soreness even when extra care has been taken to avoid it.

The study of functional conditions does not lend itself to research on the lines of physiologic optics. It is a study of symptoms and observations, and is largely empirical. Amongst the conditions causing these symptoms are the following:

1. Rheumatism
2. Debility after surgical operations.
3. Lowered nervous tone.
4. Simple anaemia.
5. Gall bladder and liver diseases.
6. Affections of the heart.
7. Menopause.
8. Premature senility.
9. Habitual constipation.

Diseases such as nephritis, diabetes, syphilis and sinus conditions mainly cause local ocular pathology and are outside the scope of this paper.

Whenever the above conditions are present, functional disturbances of vision are likely to occur, and when the correction of visual and muscular defects fails to relieve ocular symptoms they are certainly contributory.

Colour Fields of Vision

Attempts have been made to locate these general conditions through disturbances of the colour fields of vision. Such disturbances would not be unlikely, for the detection of colour in indirect vision is calling upon the precise functioning of the retinae which, if affected, should show abnormality. On the other hand, the peripheral fibres appear to be more resistant to toxins than the macular and foveal fibres, which are affected early in diseases such as retrobulbar neuritis in both its chronic and acute forms. Moreover, even the pressure of a neoplasm upon the orbital portion of the optic nerve will affect central colour before peripheral. Neverthelss the investigation into colour-field work undertaken by optometrists in America cannot be ignored; but, although open to correction, I tentatively suggest that the colour-field tests do not get us further in our clinical work with the subject under discussion, for whenever functional symptoms exist the patient is usually aware of his general condition, and history and symptoms will invariably guide us.

Treatment of Local Ocular Symptoms

It is qutie clear that general conditions must be treated by the patient's medical adviser, who must be collaborated with. The optometrist's duty is to do all that he can to relieve ocular symptoms locally. Regrettable as it may seem, many patients are only concerned with symptoms, and they seek relief for them and worry little further. Often time and station in life prevent such cases from going through sufficient medical treatment to obtain a cure, and the varying consultants have to do as much as they can to "prop" them up sufficiently to carry on their daily duties. So often the theory of the laboratory has to fall before the plain cold facts of clinical practice.

Optometrically our duty is to give these cases exact refractive assistance and attend to any muscular defects. Hygienic treatment is also important. We have already seen that functional symptoms fall under the three headings of entoptic phenomena, muscular twitchings and pain. These can be further classified into photophobia, very slight obscurations of vision and headaches.

When the conduction of light to the central visual cells is impaired, photophobia is likely, and we should endeavour to relieve the symptom with suitable absorption lenses which, at least in theory, should modify light in all wave lengths and not one in particular; consequently, we can use neutral tints or the more modern tints known as "Soft-lite."

Attention to refraction hardly needs emphasizing, and muscular defects should be given relief with prisms, as long as a cause of the functional trouble remains. Orthoptics should only be attempted when a clean bill of health is obtained, or, at least, limited to simple stereoscopic exercises. In a number of cases muscle imbalance is produced through toxic causes, especially in elderly persons who have had apoplectic troubles. Hygienic measures are directed to the soothing of the peripheral ocular nerves, which is accomplished by certain lotions; and it is in this

direction that understanding is required. If a general condition is passing toxins into the blood stream, the eyes are often irritated by congested vessels, and I have noticed that a swollen artery or vein of the anterior ciliary system will, owing to the extra space taken up, cause the feeling of foreign body, which in its turn will set up a local irritation. Consequently, astringents and vaso-constrictors are required, and give a remarkable measure of relief. On the other hand, functional conditions which are due to lowered nervous tone are only aggravated by such treatments, and I have often seen such cases caused increased suffering from them. Empirically, I have found that soothing and bland applications are the better methods to use, and a lotion of glycothymolin compound, 1 in 8, acts admirably.

I venture to say that the treatment of these conditions has been neglected in the ophthalmic sphere, and would emphasize the importance of differentiating between those conditions which throw toxins into the blood stream and those which lower tonus.

Rheumatism

Rheumatism requires special mention, for its importance in contributing to ocular symptoms has been to a large extent ignored, and it is only when local diseases such as episcleritis, rheumatic iritis and iridocyclitis occur that the cause is discussed. If rheumatic symptoms are recognized early, local disease need never arise, and to wait for such a crisis is ignoring the value of hygiene and prophylactic treatment. Cases present hardly any clinical features; a certain type of slight congestion of the anterior ciliary vessels is noticeable, but the ocular pain complained of is out of proportion to the slight congestion. Often the eyelids are said to be heavy and draw on the eyeballs, which are tender to touch. In some rheumatic cases a condition of fibrositis occurs in the cervical region which causes considerable pains, located either in the eye or from the occipital to the frontal region. Palpitations of the cervical region will disclose painful and tender areas, and there may be one or several. Until massage is undertaken no relief from the pain is to be expected. The massage is continued until the area is no longer tender to touch, when relief from the general symptoms will be obtained. I have had twelve cases of this type since September, 1934.

As most cases are presbyopic, a higher addition for reading than is usual for a given age is required, and the presbyopia is essential, showing no dynamic lag.

Treatment of the general condition is the first and the most important requirement, but a great deal can be done locally to relieve the ocular symptoms. I use two prescriptions in the interests of hygiene; alternating them avoids acclimatization. One prescription consists of sodium salicylate ten grains, chloretone one grain, glycerine ten minims to one fluid ounce of distilled water. The other is magnesium sulphate ten grains, tincture of lavender compound ten minims to one fluid ounce of distilled water. Two drops three or four times a day applied locally.

Attention to the refraction should be emphasized in the use of a distance correction with slight absorption, even when the degree of error is slight.

Decreased Tonus

In extreme cases the term neurasthenia is more applicable, but the majority of cases are not of this type, but suffer from decreased tonus. The cause may be conditions of life, premature senility, the menopause, simple anaemia and shocks through losses of relatives by death. In these cases the attention needed for refraction, absorption, and muscular error is obvious. Hygienic measures should, unless there is congestion of conjuctival vessels, be soothing and not astringent as mentioned previously. According to my experience these cases rarely have muscle-imbalance, and time is often better spent in studying the history and symptoms than making exhaustive muscle tests. The use of an absorption glass is a valuable therapeutic measure, for light worries the patient's nervous system just as noise irritates the nerves through the auditory system. Everything should be done to test the patient to assist in recuperation.

In cases of lowered tonus the pupils are often large, and this is very noticeable in simple anaemia. The large pupils manifest aberrations of the ocular optical system, and even very weak sphericals and cylindricals can be prescribed with advantage. Over-correction should be avoided, and small minus corrections should not be withheld. The prescription should include absorption.

Alcohol

In extreme cases amblyopia can be caused, but it is more common to meet cases when the habitual use of alcohol is affecting ocular functioning. When refractive examination is undertaken after alcohol has been consumed, difficulty is often encountered in completing the subjective test, and it is necessary to consider this possibility when testing those who appear to take alcohol. When the habit is well formed local conjunctival congestion can arise and cause corresponding symptoms.

As mentioned before, the study of functional conditions does not lend itself to precise research as in the sphere of physiological optics; it is a study of empirical observations, but the apparent absence of literature on the subject has led me to write this paper.

In the early stages of one's career, failure in removing symptoms is often put down to insufficient refraction, but as the years pass it is realized that there are other factors as well as local ones. These factors are functional and must be recognized.

I will conclude with the words written by the late E. E. Maddox: "Carefully collated observations, giving all the relevant facts, are of great value and enable us in the process of time to form more or less reliable judgments."

Conclusions

1. General pathological conditions can cause functional disorders of the eyes.

2. Diagnosis of cases largely depends upon history and symptoms.

3. The major treatment is medical, but much can be done to relieve ocular symptoms locally.

4. Treatment lies in the correction of refractive and muscular defects; absorption of lights and attention to hygiene. Orthoptics should not go beyond simple stereoscopic exercises until the general condition is removed.

5. Differentiation between toxic and low tonus conditions when applying hygienic treatment is important, and probably a new line of thought.

6. Attention to such cases will prevent ultimate local ocular pathology.

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A CHRONOMETRIC TECHNIC FOR THE TESTING OF OCULAR MUSCLES: PRELIMINARY STATEMENT*

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Modern oculomyological testing methods are based almost entirely upon angular measurements. Thus the distribution of tonus between pairs of antagonistic muscles in a condition of physiological rest is expressed in terms of the number of degrees by which the visual axes of the two eyes deviate from parallelism. Likewise, efficiency values, or blur and diplopia thresholds for any specific fixation distance, are expressed either in degrees or in prism diopters. Hence angular values are in all cases the indices of relativity and efficiency of ocular muscles, and serve as bases for diagnosis. It will be seen from a study of methods used in general physiology that there exists another criterion, the application of which to the analysis of binocular activity has been neglected. This concerns the temporal factor and it assumes appreciable significance in the complexity of binoculomotor adjustment.

Following several years of experimental work concerned with the time relationships between antagonistic extrinsic ocular muscles and the effect produced upon these relationships by varying accommodative effort, the chronometric technic has been successfuly applied to vision by the writer. Instrumentation suitable for clinical purposes has been developed whereby it is possible to measure the duration of diplopia, and hence the speed of readjustment of the visual axes, following upon the application or removal of prisms.

The procedure as well as the instrumentation is characterized by simplicity. Prisms are inserted in clasps adjustable for the interpupillary distance and mounted upon a horizontal bar, the midpoint of which is attached to a vertical column capable of movement within a cylindrical enclosure. A handle on the vertical column permits the operator to move it up or down, and by this means the prisms are either applied to or removed from the eyes. Through the medium of adjustable platinum points an electrical timing device is activated as the prism edges cut the visual axes or simultaneously with the production of diplopia. The patient releases the pressure of his index finger upon a reaction key imme-

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diately diplopia is abolished, this action stopping the timer. Thus a measure of the duration of diplopia is obtained in time units of one-hundredths of a second. The fixation object consists of a horizontal or vertical line, depending upon the type of diplopia which is being measured.

Since individual differences in the speed of binocular readjustment exist, analysis of the results must not be based upon a consideration of speed *per se* but rather upon some relationship of speeds within a particular visual apparatus. For example, if equal amounts of positive and negative convergence are timed, the results must be expressed as a ratio. This ratio is obtained by dividing the time required for a negative convergence reaction by the time required for a positive convergence response of equal amount. This is the *Convergence Index* and it possesses a certain value for normal individuals. Since time is an inverse measure of efficiency this index is below normal in individuals whose convergence is understimulated, and conversely it is above the normal value in cases of overstimulated convergence. The ratio may be changed by varying accommodative effort or by other methods at the disposal of the refractionist, and hence it serves as an important diagnostic tool.

The data gathered thus far indicates a definite correlation between the angular, or standard tests, and the chronometric technic. In many cases, however, where visual discomfort was reported, standard tests revealed no imbalances whereas disturbed convergence indices were observed through the use of the chronometric technic.

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MYOPIA*

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In order to understand the present day problems of Myopia it is well to give a brief general outline of myopia as understood about the time 1880. I choose that date, 1880, for the reason that the greatest progress in gaining knowledge of Myopia was made from 1723 to about 1880. I have referred to such writers as Helmholtz, Tcherning, Landolt, Von Graffe, Donders, Jaeger, and others, and I have condensed their theories on Myopia into the following brief outline:

Definition:

Myopia is that condition of the eye in which the focal length of the refractive system is too short for the Anterior-Posterior length. Myopia was divided into three divisions, namely

1. Axiel
2. Refractive
3. Myopia combined with a physical disturbance affecting the entire system.

Axiel—The Anterior-Posterior length greater than the refractive system of the eye.

Refractive—High radius of Curvature of the Cornea. Extremely short focal length of the lens. Difference in the index, etc.

The causes of Axiel Myopia, as understood then, are of the most interest, and were three in number.

1. Hereditary
2. Occupational
3. Spasm of Accommodation

Hereditary—The predisposing factor from parents. This was at that time accepted as unquestionable.

Occupational—Poor illumination; over-application of the eyes for close work; stooped position for close work; class distinction and a few others.

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*An abridgment of the material presented before the Minnesota Academy of Optometry at Minneapolis, Minn., Sept. 20, 1935.

Note: The two (Hereditary and Occupational) when found together gave rise to the pressure theory as follows: (a) the interocular pressure was increased by the internal and external recti in strong convergence, or (b) The pressure of the fluids was increased by accumulation of blood in the eye while the patient was in a stooped position; (c) Congestive processes of the fundus lead to softening in the normal eye, or more so under increased pressure. The five congestive processes were:

1. Atrophy of the Choroid
2. Atrophy of Optic Nerve
3. Extension of the Retina
4. Circumscribed changes of the Fovia
5. Dessemminated Choroiditis

These five, or any one or combination of them, it was thought, caused the fibres of the Schlera to stretch at the Posterior Pole, thus causing myopia.

Spasm of Accommodation—This was considered an anomolie of Accommodation, which was recognized as causing false Myopia and also a factor in cases that were hereditary by nature.

The nineteenth century treatment of Myopia was, refractively, as follows:

1. Minus lenses for best Visual Acuity
2. Lenses and Prism Base-in, in cases of Convergent Insufficiency
3. Special attention was given to hygienic conditions and every effort was made to protect the patient from any influence that would tend to increase the Myopia, such as over-correction, poor illumination, etc.

A summary would indicate the belief that some Myopia was in a degree at least combined with a toxic condition affecting the entire system and the problem, one of preventing it from increasing; the treatment one of employing lenses, and giving hygienic advice. Every step was taken to avoid over-stimulation of accommodation and convergence.

The next important step in our knowledge of Myopia occurred some time later and was termed Pseudo Myopia or a condition of Real Myopia with Over-Accommodation, Spasm of Accommodation, or Hyper-tension of the Positive Muscles of Accommodation, or various other names. This false Myopia could be eradicated and the following methods were tried:

Prism base-in constant wear; Physical Therapy; Repression lenses; Prism base-in exercises. Success was a matter of 50% or less with any method used.

The Calcium Theory, the Vitamin Theory, and the Endocrine Theory have been propounded. As to their success I cannot say, but I presume they are so far untried theories with success in an occasional case.

In 1935 the problem confronting us is one of checking progressive Myopia, recognizing and eliminating Pseudo-Myopia, if possible, and

attaining a better understanding of the "why" of Myopia.

Myopia today is divided into 4 distinct types:

1. Functional (Accommodative); false or Pseudo Myopia caused by over-accommodation.

2. Myopia combined with a physical disturbance affecting the entire system (Toxic, Visceral, Endocrine); Myopia affected by Toxema, 80% of which originates in the head.

3. True (Axiel); Anterior-Posterior length too long for Refractive system of the eye, or *Anterior-Posterior length Normal but excessive Focal length of lens.*

4. Psychic; Myopia from Shock, Fear, Worry, Anxiety, etc.

Obviously if there are four different types of myopia it is necessary to differentiate between the various conditions and this can best be done by a careful analysis of the refractive findings. Keeping in mind the patient's uncorrected visual acuity and a more or less standard refractive procedure, this analysis can easily be made.

The following procedure is one that I follow in every Myopic case. It may seem unusually long and repeated in some instances but I have found that repeated check tests are valuable and of importance in any refractive case.

Uncorrected Visual Acuity
Corrected Visual Acuity
Versions
Cover and Fixation Test
Pupillary Reflex Test
Size of Pupils
Ophthalmoscopic Examination
Ophthalmometer findings
Skiametry static
Dynamic skiametry
    (a) Sheard technique
    (b) Tait technique
    (c) Peckham technique
Cyclodamic re-check
Subjective finding
    (The following tests are all made uncorrected and corrected)
Phoria at 6 meters
Near Phoria
A record made of physiologic exophoria
Abduction at 6 meters
Negative relative convergence
Positive relative convergence
    (Tests are also made on accommodation)
Negative relative accommodation
Positive relative accommodation

Lawrence gives the following cause for diminished visual acuity in Myopia: Light is brought to a focus in the Vitreous, and overlapping circles of confusion are formed on the retina which are directly proportional to the degree of Myopia.

Table of visual acuity for myopia of less than 3.50 diopters.
Visual acuity of 20/30 equals 0.50 diopter of myopia
Visual acuity of 20/40 equals 0.75 diopter of myopia
Visual acuity of 20/60 equals 1.00 diopter of myopia
Visual acuity of 20/80 equals 1.50 diopter of myopia
Visual acuity of 20/200 equals 2.50 diopter of myopia

The following case report is one of True or Axiel myopia combined with a functional disorder or an accommodative problem. The refractive findings were as follows:

Uncorrected visual acuity O.U. 20/200, O.D. 20/200, O.S. 20/200
Versions slightly jerky
Cover and fixation test, normal
Pupillary reflexes, normal
External ocular inspection, normal
Size of pupils, 6 mm.
Ophthalmoscope, negative
Ophthalmometer, negative
Static skiametry
O.D. —4.00 D.Sph.
O.S. —4.00 D.Sph.
Tait Dynamic Skiametry
O.D. —2.50 D.Sph.
O.S. —2.50 D.Sph.
Sheard Dynamic Skiametry
O.D. —1.50 D.Sph.
O.S. —1.50 D.Sph.
Peckham Dynamic Skiametry
O.D. —4.50 D.Sph.
O.S. —4.50 D.Sph.
Cyclodamic test
O.D. —3.00 D.Sph.
O.S. —3.00 D.Sph.
Subjective tests
A.D. —4.25 D.Sph.
O.S. —4.25 D.Sph.
Uncorrected phoria at 6 meters, 2° exophoria
Uncorected phoria at 33 cm., 4° exophoria
Uncorrected physiological exophoria, 2° exophoria
Corrected phoria at 6 meters, 2° exophoria. Note: This finding is the same as the uncorrected phoria finding.

Corrected phoria at 33 cm., 2° exophoria. Note: This finding is less than the uncorrected phoria finding at 33 cm.
Corrected physiological exophoria, none. Note: This finding is less than the uncorrected physiological exophoria.
Uncorrected abduction at 6 meters,
12△ break, 10△ recovery
Uncorrected negative relative convergence,
24△ break, 20△ recovery
Corrected abduction at 6 meters,
△ blur, 12△ break and 8△ recovery
Corrected negative relative convergence,
10△ blur, 18△ break and 14△ recovery
Note: This finding is lower than the uncorrected negative relative convergence finding.
Corrected negative relative convergence with +1.00 D.Sph. added O.U.
14△ blur, 24△ break and 20△ recovery
Corrected negative relative convergence with +2.00 D.Sph. added O.U.
0△ blur, 26△ break and 23△ recovery
Corrected negative relative convergence with + 2.50 D.Sph. added O.U.
0△ blur, 23△ break and 20△ recovery
Negative relative accommodation,
O.U. —3.75 D.Sph.
Note: A +2.00 D.Sph. does not change the size of the letters. Additional plus causes magnification.

In this case the positive relative convergence tests and the positive relative accommodative tests were omitted as their use would tend to increase the already high hyper-tension of the ciliary muscles.

The treatment in this case was as follows: The subjective findings which gave 20/20 visual acuity were prescribed for distance wear. To this was added 1△ of base-in prism over each eye. A grab front correction for near work was also prescribed, this being fitted with O.U. +2.00 D.Sph. Base-in orthoptic treatments might also have been prescribed, had the case seemed to require it. This correction was used with comfort.

The next case report deals with a case of true myopia showing an exophoria at 6 meters due to wearing an overcorrection. The refractive data follows:

Uncorrected visual acuity O.D. 20/200, O.S. 20/200, O.U. 20/200.
Corrected visual acuity with old correction, O.U. 20/20.
Old correction was O.U. —4.25 D.Sph.
Versions, cover test, fixation test, pupillary reaction test, external ocular inspection, ophthalmoscope and ophthalmometer all negative.

Static skiametry
O.D. —4.25 D.Sph.
O.S. —4.25 D.Sph.

Tait Dynamic Skiametry
O.D. —2.00 D.Sph.
O.S. —2.00 D.Sph.

Sheard Dynamic Skiametry
O.D. —2.50 D.Sph.
O.S. —2.50 D.Sph.

Peckham Dynamic Skiametry
O.D. —4.00 D.Sph.
O.S. —4.00 D.Sph.

Cyclodamic test
O.U. —2.50 D.Sph.

Subjective test
O.D. —3.50 D.Sph. = V.A. 20/20.
O.S. —3.50 D.Sph. = V.A. 20/20.

Phoria test at 6 meters using old correction, 2° esophoria.
Uncorrected phoria test at 6 meters, 2° esophoria.
Phoria test at 6 meters using subjective findings, 3° esophoria.
Phoria test at 33 cm., using old correction, 2° esophoria.
Uncorrected phoria test at 33 cm., 2° esophoria.
Phoria test at 33 cm., using subjective findings, 3° esophoria.

Uncorrected abduction test at 6 meters,
8△ break, 6△ recovery.

Corrected abduction test at 6 meters,
8△ break, 6△ recovery.

Corrected negative relative convergence, with old correction,
6△ blur, 14△ break and 8△ recovery.

Uncorrected negative relative convergence,
10△ blur, 16△ break and 8△ recovery.

Corrected negative relative convergence, with subjective finding,
5△ blur, 12△ break, and 7△ recovery.

Corrected with subjective finding, negative relative convergence test with +1.00 D.Sph. added O.U.
17△ blur, 23△ break and 15△ recovery.

Corrected with subjective finding, negative relative convergence test with +1.50 D.Sph. added O.U.
19△ blur, 22△ break and 16△ recovery.
Note: This is the best finding.

Corrected with subjective finding, negative relative convergence test with +2.00 D.Sph. added O.U.
19△ blur, 21△ break and 10△ recovery.

A +1.50 D.Sph. was then added to the binocular subjective finding in a trial frame and the patient wore this for a 15-minute

period while resting. The phoria tests were then made with this correction in place.

Phoria test at 6 meters, 1° esophoria.
Phoria test at 33 cm., 4° exophoria.
Physiological exophoria, 5° exophoria.

In this case the positive reserves at near-point were not taken as in so doing it increases the findings of the negative relative convergence tests by overstimulation.

Bifocals were prescribed in this case as well as base-in orthoptic treatments. Case later discharged with complete comfort. There are few of these cases in the myopic group.

The number of cases of true myopia are many. The number of cases of true myopia combined with functional, accommodative or pseudo myopia are few. The number of cases of pseudo or false myopia are also few in number but by no means scarce. However, these types of myopic cases can all be refracted and corrected without too much difficulty. The real problem cases are those of myopia combined with some sort of a focal infection or toxemia. These cases are by no means rare and constitute one of the major problems confronting both the optometric and medical groups of refractionists. In these cases the diagnosis is very difficult to make and even when made the case still presents a problem as the correction frequently fails to give relief and the patient remains dissatisfied. This type of case falls as a rule within the pathologic chain in the Graduate Clinic Foundation work but this in itself does not satisfy the condition. Something must be done about the condition to relieve it and merely referring the patient to his or her family physician accomplishes, as a rule, very little indeed. Focal infections and toxic problems, are as a rule, somewhat difficult to locate, and unless you call into consultation a physician who really understands the patient's and your own problem in this type of case, his search is not apt to go deep enough to locate the seat of the trouble. That these cases must be referred to some medical specialist is obvious, but the fact remains they should only go to one who will take the time and make the effort required, to search out and correct the underlying condition which is aggravating the neurological phase of this myopic problem. Once this is done, the case resolves itself into one of simple myopia and is satisfactorily corrected as such.

It is interesting to observe also in these cases that prismatic orthoptic treatments accomplish nothing at all until proper medical or dental interference has removed the focal infection or the source of the toxemia. Here too, the optometrist must be on his guard as the findings may indicate the need for prismatic treatments which in these cases will give little or no relief. The following case indicates the type of refractive findings found in cases of this sort.

Uncorrected visual acuity, O.U. 20/200.

Versions, cover test, fixation test, pupillary reaction test, ophthalmoscope, ophthalmometer and external ocular inspection all negative.

Skiametry Static,
O.U. —2.00 D.Sph.

Skiametry Dynamic (Tait),
O.U. —1.50 D.Sph.

Skiametry Dynamic (Sheard),
O.U. —1.50 D.Sph.

Skiametry Dynamic (Peckham),
O.U. —2.50 D.Sph.

Cyclodamic test,
O.U. —3.00 D.Sph.

Subjective test.
O.U. —1.75 D.Sph. = V.A. 20/30+.

Uncorrected phoria test at 6 meters, 4° esophoria.

Corrected phoria test at 6 meters, 5° esophoria.

Uncorrected phoria test at 33 cm., 5° esophoria.

Corrected phoria test at 33 cm., 6° esophoria.

Physiological exophoria, 1° exophoria.

Uncorrected abduction test at 6 meters,
3△ break, 1△ recovery.

Corrected abduction test at 6 meters,
3△ break, —1△ recovery.

Uncorrected negative relative convergence,
17△ blur, 27△ break and 8△ recovery.

Corrected negative relative convergence,
19△ blur, 26△ break and 9△ recovery.

Corrected negative relative convergence with a +1.00 D.Sph. added O.U.
18△ blur, 26△ break and 4△ recovery.

Corrected positive relative convergence,
6△ blur, 10△ break and 0△ recovery.

Negative relative accommodation +0.75 D.Sph. Not raised by base-in prism.

This case resolved itself into a case of average true myopia after treatment by a physician to whom I first referred him, and the patient now has a normal refractive condition for the first time in years.

The following chart indicates some of the principle differences in refractive findings between functional, accommodative or pseudo myopic cases and those myopic cases which are combined with some form of focal infection or toxic disturbance.

REFRACTIVE TEST OR FINDING	FUNCTIONAL, ACCOMMODATIVE OR PSEUDO-MYOPIA	MYOPIA COMBINED WITH A FOCAL INFECTION OR TOXIC DISTURBANCE
Corrected Distance Phoria	Esophoria caused by overcorrection	Correction has no effect upon Esophoria
Amount of Esophoria at 6 meters	Increased by full corection	not changed by correction
Amount of Esophoria or Exophoria at near-point	Esophoria decreased or Exophoria increased by full minus correction	not changed by correction
Uncorrected Physiological Exophoria test	variable	always low
Corrected Physiological Exophoria test	Amount decreased by full minus correction	not changed by correction
Corrected negative relative convergence	Blur,—low Break,—unusually low Recovery,—poor	Blur,—usually none Break,—always low Recovery,—very poor
Corrected negative relative convergence with added plus	Blur,—raised Break,—raised Recovery,—raised	Blur,—no change Break,—no change Recovery,—always worse
Static Skiametry at 6 meters	Higher than subjective	Higher than subjective
Dynamic Skiametry findings	variable	variable
Negative relative accommodation	variable	usually poor
(a)	(a) if the dynamic skiametric finding is high in lag the negative relative accommodation will be high	(a)
(b)	(b) if the dynamic skiametric finding is low in lag the negative relative convergence will be low also but will increase with prism base-in.	(b) if the dynamic skiametry finding is low in lag the negative relative convergence will be low also but will not increase with prism base-in
In general it might be said that	there are but few of these cases	there are somewhat more of these cases

There is one other type of Myopia case that may have either an esophoria or an exophoria at 6 m. The whole examination or series of examinations give no concrete information but the findings are to be wondered at. This is the most unstable of any ocular error. This type of Myopia is called Psychic. Its causes are fear, shock, worry, anxiety. The important ocular manifestations are: extremely large pupils combined with esophoria, reduced visual acuity, and accommodative anomolies such as spasm of accommodation. The main diagnostic factor is Permitry, in which one is apt to find reversal of color and form fields.

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A BASIC TECHNIQUE IN ORTHOPTICS*

Part V.

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Successful handling of orthoptic cases, and more especially cases of strabismus, depends not so much on the instruments used as on the technique employed. I believe that I have stressed this point repeatedly in this series of papers and I am repeating it again. Each case must be analyzed and diagnosed properly and accurately. When that is done, all important data must be recorded. All material pertaining to this case record must be kept with the record, thus being constantly at hand in case the information it contains is desired. Included in this material is the treatment program which the orthoptist must outline as the preliminary step in training prescribed for each case.

In general, the essential steps in training a case of strabismus are definite and are indicated in the sequence given. Experience teaches us that there are no short cuts in the training of strabismus and that slow, patient, persevering and often nerve racking work, may, if persistently carried on, produce the most amazing results. This, many orthoptists will attest.

The first step in handling any type of orthoptic case is the outlining of a definite plan of training. The program is based on the symptomatology and on the indications shown in the various tests. It may be necessary to repeat tests in order to determine accurately the extent of the defects the methods to be employed in their correction. When this matter is definitely settled and a program is drawn up, it represents the working outline upon which training is based.

A diagrammatical sketch depicting step by step the training of an orthoptic case will give the orthoptist a clearer understanding of the procedure which I am employing and which I endeavored to present in this series of articles. In main, these steps constitute the basic technique. A great deal more is necessary to actually accomplish the task undertaken. There are numerous techniques which can not be described and which are essential to produce the results desired. These are developed and devised in the course of the training. The essential steps, however, require careful

*Submitted for publication November 22, 1935.

watching, checking, and the interpretation of the patient's reactions in terms of information, either favorable or unfavorable.

Essential Steps in the Training of Squints.

1. Establish visual perception in amblyopic eye.
2. Elimination of suppression.
3. Macular fixation.
4. Projection.
5. Monocular Fixation.
6. Simultaneous Binocular fixation.
7. Diplopia.
8. Superimposition.
9. Duction.
10. Fusion.
11. Stereopsis.

The eleven steps outlined apply to all cases in which vision in the strabismic eye is amblyopic and where there is complete absence of the fusion sense. In cases of heterophorias steps 9, 10 and 11 may be sufficient. Likewise, in cases of squint where visual acuity is unimpaired, step 1, and even 2, 3 and 4 may be eliminated, although it is not always advisable. It must be remembered that a strabismic eye is an abnormal eye, and even if there appears to be fairly good visual acuity, it is not constant—or at least not as constant as the acuity in the fixing eye. In addition, there may be periodic suspension and suppression, the existence of which is indicated by a periodic strabismus. Constant strabismus generally shows amblyopia in the squinting eye. It is in the periodic types and in the alternating types that we find fairly good visual acuity. The safest rule, therefore, is to stimulate the acuity of vision in the squinting eye, regardless of the case, if one finds it at all subnormal.

The steps outlined are a generalization of the procedure. These steps could be made many times eleven, if I were to subdivide them into lesser, or approaching steps. There is an interdependence of one step over the next, and, so in sequence, the entire routine depends upon each one of its constitutent steps. An orthoptist should not resort to short cuts, nor should he attempt to eliminate steps, no matter how irrelevant, or insignificant, or unimportant, they may seem. It may be that these seemingly unimportant steps may actually be the connecting links in the corrective technique and a case may fail of development because these were overlooked, or their importance underestimated. An orthoptist should carry out his program to a letter. It is frequently necessary to repeat a step, time and time again until it literally becomes monotonous both to the patient and to the doctor. But if we are to consider that orthoptic training is in reality an educative process and not a system of exercises or calisthenics, as some prefer to style it, then will it be understood why it is so imperative to follow the outlined plan and why repetition, to a point of visualization, is so necessary.

Furthermore, the orthoptist must be possessed of a fair degree of imagination and be able to impart some of it to his patient. He must also be able to put the case squarely to his patient and to make him understand what is expected of him. Cooperation on part of the patient is as essential as is the orthoptist's capability and understanding in handling the case.

In the preceding articles of this series I outlined the methods and procedures for the eleven steps. An orthoptist, in handling a case may find it necessary to add to my outline, when such is the indication, but experience has taught me not to take chances with reducing the number of steps. Close study of the outline will convince an optometrist who understands orthoptics that each step is important and that it leads in sequence to the next, and the next, until the program is completed.

Commencing with the initial procedure, as is common in cases of strabismus, the conditions of amblyopia presents a problem of no mean significance. To eliminate this condition calls for a great deal of ingenuity and hard work. I mentioned in a recent article an attachment which I described as Retinal Stimulator and have since received numerous inquiries on its construction. It is a simple device made up from tin about the size of a soup can. This cylindrical piece of tin was then attached to a piece of wood to which I connected an electric socket, wired. I used the wood as an insulator. I attached the stimulator or flasher to the Telebinocular head to which it fits snugly and by means of a flasher alternate light and darkness before the eye. The tin surface reflects the light and helps to throw it into the eye. I use colored filters in conjunction and other devices which seem to materially help in the development of amblyopic eyes. In addition, other methods are employed by which the non-seeing eye is taught how to see.

Steps 2, 3 and 4 are actually parts of step 1, yet a definite line of demarkation exists, theoretically, at least, which indicates where each one ends and the other begins. In an effort to eliminate suppression by an amblyopic eye, the eye is put to work. Flashing light into it is but one phase. Colored slides, filters, cards, letters, tracing, with the pad placed in front of the poorer eye, are some of the methods employed. They all tend toward creating a desire for seeing continuously and without interruption, even if monocularly. Projection training is instituted in an effort to re-educate the normal macula and to eliminate the false area produced by the squint. There are many means for doing this and each orthoptist has his own favorite method. Hand and eye co-ordination seem the most scientific methods, but it is wise to change this for other means in the course of training. In the early stages of projection training, especially if the visual acuity is very low, I have the patient pick out and outline letters on a Snellen chart and as improvement is noticed, the size of letters are reduced, as well as the distance. A long pointer is then used with which the patient identifies the characters on the card. Tracing books, circling and outlining letters on newspapers, are excellent media and help to produce good results.

Monocular fixation is a prelude to the more intricate Simultaneous Binocular Fixation. Dissimilar targets are shown to the two eyes, intermittently. After several such exposures, both eyes are uncovered and notice is taken if there is binocular perception. Frequently, especially when there is a marked degree of suppression, simultaneous binocular perception will come after considerable effort. It has been my practice, as soon as my patient appears to be ready for monocular and simultaneous binocular perception training, to place a picture of some sort, usually colored, in front of the better eye and the stimulator in front of the poorer one. The picture is not illuminated, but when the flasher goes on, the patient will see both, the bulb and the picture, usually instantaneously. A carmine two cent postage stamp pasted on a white card will serve the purpose. I spend a lot of time on simultaneous binocular perception training. This step frequently opens the superimposition and duction training. At this stage it frequently happens that diplopia occurs. This is the very initial objective toward which we strive.

The creation of diplopia is an indicator that both eyes are seeing equally together. It is therefore an indication that suppression has been eliminated. When my patient reaches this stage, I strongly urge him not to try to eliminate the second image, but to keep seeing it.

I explain to the patients the imporance of diplopia in his case and find that they are anxious to cooperate, albeit it means considerable annoyance and frequently actual danger.

With diplopia established, the actual training of the fusion faculty commences. The first step in this direction is to establish superimposition of one image over the other and the best method in doing this is to use dissimilar targets, such as a Bird and Cage, Circle and Star or Jack and a Box. The technique is to have the Bird put into the Cage; the Star into the Circle or Jack in the Box. It requires a considerable amount of ducting power to accomplish this act and it serves as a starter in the training of muscular coordination. For the training of duction, non-stereoscopic but similar pictures or objects are better. The object is to superimpose one picture over the other and to produce fusion, to a point of diplopia, then back to relaxation. By so doing, duction amplitude is increased. It is not possible to weaken a stronger muscle by exercise, but it is possible to build up weaker muscles and thus make them stronger than the antagonistic muscles. Fusion training is continued in a similar manner, but using stereoptic cards, which produce greater results. The feeling of depth and the ease with which the two objects are blended, differentiate the two parts of this procedure. Cards with colored backgrounds, or cards with the fixation objects in colors, seem to make better fusion targets. When the maximum duction has been attained and easiest fusion developed, it is safe to train stereopsis. This being the last step in the development of the co-ordinate functions of visual perception.

This outline briefly sums up the Basic Techniques in Orthoptics. The program can be applied to Heterotropias as well as to Hetero-

phorias, with some exceptions. In Heterophorias the entire program is not called for. In Heterotropias it is. In alternating strabismus certain modifications are necessary in order to create the desire for diplopia. Prisms in conjunction with the slides or cards are of great value in the alternate monocular fixation exercise. The procedure calls for strong Base-Out prisms in Convergent Strabismus and Base-in prisms in Divergent Strabismus. The cards are placed to produce Base-Out and Base-in effect, respectively. This technique tends to produce an effect opposite to the condition existing, and causes diplopia. Monocular fixation is produced by uncovering each eye alternately, and then both eyes together. The prism effect is gradually reduced, after a while, by either using weaker powered prisms or by producing contrary effect with the cards. The powers of the prisms depend on the condition and vary from 15△ to 60△, or more. I am trying out vertical prisms in alternating strabismus cases, at the present writing and shall note their reactions and efficacy in producing diplopia. The Basic Technique calls for the production of diplopia prior to the establishment of fusion, as the first step in the re-educative process following the development of the visual acuity. By establishing diplopia, the patient is reverted to the stage which has caused the strabismus. Had the significant symptom of diplopia been properly recognized and interpreted at its first occurence and steps taken to alleviate it by proper methods, strabismus would not have become manifested. In training, it was found most beneficial to re-institute this symptom by reverting the patient to very beginning of the condition. It is a manifest condition reverted to its incipiency.

The rules given in the outline are not inflexible. They permit of changing; and they permit of modification. What I am trying to present is a basic technique for the use in all types of cases and with any type of equipment. Basically, all instruments for orthoptic practice are constructed on the same principle, only some have means for rotating the targets. The question of motility is rather important. It has not been proven that motility is absolutely essential in the training of strabismus, nor has it been proven to the contrary. But whether motility is indicated or not, can be left to the individual orthoptist and when necessary he can improvise motion on the instruments which he has, or he can secure one which is equipped with a movable stage on which the targets are mounted. The essential points in the training of strabismus, and this applies to heterophorias also, is to re-educate the visual centers in the brain and to train them to follow the natural pathways in the co-ordinate visual act. The technique outlined in this, and in the other four papers, merely cites a method of procedure which has, by actual clinical application, produced the best results. If examined very closely, the Basic Technique follows very closely the physiological development of vision. What we attempt to do, then, is to emulate nature.

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OPTOMETRY AND THE PREVENTION OF BLINDNESS

As optometrists it is our duty to share in the work done in the field of prevention of blindness. This field is none too well defined, being as it is more or less divided, first on one hand, by several professional groups dealing with vision and on the other hand by various social welfare, school and state bodies dealing with the blind and those with subnormal vision. However, as a preventive problem, it might be said that perhaps well over two-thirds and perhaps about three-fourths of all present blindness might have been avoided by the application of means, now known to us. A certain portion of these cases are to be ascribed to infectious diseases, either affecting the eye particularly or they result as the consequence of disorders of more systemic character. With timely, suitable, and skilled attention in either case, including attention to the aggression of such diseases upon the organs of sight, we may be sure that a very considerable proportion of blindness in the future from both local and general diseases may be checked. The optometrist has his place in this field as a diagnostician whose duty it is to early weed out these individuals and see to it that they receive the proper medical treatment at the hands of medical specialists.

Of the various causes of blindness one infectious disease in particular is most readily brought under control. This is an infant malady or ophthalmia neonatorum, which, according to Best[1], has been responsible for a large part of all the blindness and subnormal vision found here in America. This infection can be checked by the employment of a certain easily applied prophylactic at birth, or shortly thereafter. The germ involved is in this manner definitely destroyed and the child's eyes saved. The process is such a simple one, performed at such a trivial cost, that it would seem to have come into general adoption immediately after there had been some positive knowledge of it. This, however, has not proved to be the case. In many areas there has been considerable negligence. It has been necessary that the law intervene and impose the proper requirements. Even then the enforcement of the legislation enacted has not always been of extended character but in the more enlightened communities there may now be noted an increasing insistence in this direction. In most localities the situation is fairly well in hand that there are now but few cases of blindness occurring from ophthalmia neonatorum. The optometrists' place in regard to this particular infectious disease is one of advice only to prospective mothers. Her insistence that the drops be used in the child's eyes immediately after the delivery will insure it being done by either the midwife or the physician in charge at that time.

Another disease, trachoma by name, is the cause of very much blindness in certain sections of the country. This likewise lends itself to simple and efficacious treatment if diagnosed in time. By the adoption of proper, and what should be general, sanitary measures, as well as by timely medical treatment, it may be greatly reduced in extent if not wholly eliminated. Here the optometrist comes into the field as a diagnostician. In making the external-ocular-inspection portion of his examination, with focal-illumination or the slit-lamp, it is inconceivable that an infectious disease like trachoma of the lids and its resultant action on the conjunctiva and cornea could be overlooked. In fact, all cases showing a decided inflammation of the lids as well as a marked discharge should have medical attention at once.

Even such diseases of the eye as cataract and glaucoma may in an enlarging number of individual cases prove amenable to timely and skilled medical treatment. This also is true with respect to certain other less well-known ocular affections. For the remainder of the diseases that cause blindness we shall have to wait upon the development of medical science, both in the study of diseases and in their treatment, though much also can be accomplished by the general enlightenment of the public with respect to them. In the preservation of the general health and in the avoidance of conditions likely to bring on an impairment of the sight, we may expect a proportionate reduction in the total amount of blindness. Here too, the optometrist in making his refraction can serve in an im-

[1] Harry Best. Blindness and the Blind in the United States. The Macmillan Company, New York City. 1934. Page 84-85.

portant capacity in diagnosing these abnormalities and calling in, in consultation, specialists to treat the abnormality. The optometrist here too can be of value in his advice to his patient in the important matter of ocular hygiene with reference pertaining to glare, illumination as well as the use of the eyes themselves.

Blindness occurring from injuries and accidents to the eye opens a big field for prevention work. Perhaps the first step in this direction lies in the securing of proper and sufficient lighting facilities everywhere—in the school, in the home, in the workshop, and in places of public assembly of what ever kind. Here the optometrist can be and is of marked value and we may believe that the increased concern that is today being displayed in this matter is to a large degree due to our efforts along this line, and that in time to come there will be an ever lessening damage to the eye from bad lighting and the visual fatigue which results from it. In this campaign there must also be a warning as to the peril involved in general neglect of the eyes when the symptoms indicate a need for attention. Of the eyes of school children in particular, there must be periodical examination, with proper correction and treatment when needed. For those whose vision is seriously defective, special "sight-saving" classes either are or should be established. To such an extent has this last matter come to be realized that within recent years classes for children with sub-normal vision have been inaugurated in many communities and the time is probably not far distant when they will have a place in school programs practically everywhere. Then too, attention must be given to the dangers to the vision which may result from carelessness or want of caution in certain occupations or pastimes or perhaps even in the general activities of life. To all of our patients must be brought home the realization of the more or less constant risks to which the eye is exposed along with the inclusion of lessons of heed and prudence. Here, too, there is full opportunity for an organized campaign of instruction for the public and here too the optometrist must take a place as a leader in his community life in stressing these lessons in preventive optometry.

In addition to the foregoing, a considerable portion of blindness from injuries is attributable to industrial conditions which are quite beyond the power of the optometrist to control, and for which industry as a whole is mainly to blame. Dangerous occupations have exacted too heavy a toll in the way of blindness, and failure to provide adequate protection has darkened the life of many a worker, often in his prime and vigor. The duty of furnishing proper safe guards would seem to be one imposed upon the management by ordinary interest in the welfare of their workers, but where this is lacking the law should see to it that in all factories and other industrial establishments in which men are engaged at work there must be installed devices of such character as to prevent ocular injuries. Attention should be given to protecting the eye not only against particles and objects striking the anterior surface of the eye but also against intense heat and light. Also against drugs and

chemicals the fumes or vapors of which may prove harmful. As a final measure for saving the sight, there should be included in all working men's compensation laws definite and distinct reference to injuries affecting vision, with the compensation to be afforded in the event of the loss of sight, so high, that it will be to the advantage of employers to equip their plants with any and all visual safeguards. Optometrists should take part in activities of this sort. It is not asking too much of professional men to expect them to interest themselves in the welfare of whole groups of the public and their ocular problems, and as a profession it is our duty and privilege to do so. Our societies too should be active in this phase of optometry as much of value would result.

And finally for that form or type of blindness which may be called hereditary, we need not have, as far as its extent is concerned, special alarm. This whole matter is a part of the general question of heredity, of which our optometric knowledge is slight; but so far as the writer can find, the amount of blindness that is inherited is not on the whole great. To be sure, in certain families a strain of blindness is plainly to be discovered, and to the possibilities in respect to these types of cases there should be given full heed. However, the actual operations of hereditary forces are as yet very obscure, whether we regard these as manifesting themselves through particular diseases, or whether we regard them to be, not so much in the transmission of blindness itself, as in the passing on of a particular disorder, liable to result in blindness, or of a certain predisposition or tendency towards blindness itself. From what we as optometrists are now able to learn, the diseases of hereditary character which may produce blindness are of a limited number, only a few being of any considerable extent.

In the matter of consanguineous marriages there is evidently also a certain part played in the causation of blindness, though this, relatively speaking, is likewise but small. Referring to the hereditary effects of marriages of the blind, there seems to be, all in all, but little ground for worry. Such marriages are, as a rule, infrequent, unions of the blind with the blind being on the whole a rather uncommon occurrence, and as a general thing medical literature indicates that they are little likely to result in blind offspring, in fact, hardly more so than are unions of the blind with the seeing. The real danger in the matter seems to lie in the marriage of persons, whether blind or sighted, especially such as have blind relatives, who also have one of the particular diseases which are liable to be transmitted. It is here that attention is to be focused, and that perhaps drastic measures may be called for and it is here too that optometrists can and should play an important part in the dissemination of proper advice to the affected parties.

Thus it becomes evident that as optometrists in dealing with this problem of prevention of blindness we have before us a five-fold duty to perform. First, as professional men we must carry on our refractive work in such a manner that nothing in the way of a diagnostic syndrome of

ocular pathology escapes our attention. Second, on discovering evidence of ocular pathology and diagnosing its character, we must call in consultation, the proper medical specialist at once, to assist in checking and curing the malady if possible. Third, as professional men it is our duty to advise our patients in the matter of ocular hygiene and safety. Fourth, we must as a collective professional group support the proper types of social legislation which will enhance safeguarding the vision of this nation and last we must as public spirited citizens join with other lay and professional groups who have as their chief interest the protection of vision and the care of those already suffering from sub-normal vision or blindness.

Carel C. Koch.

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SPECIAL REPORT

ADDITIONAL RESEARCH WORK IN ANISEIKONIA*

Dr. Alfred Beilschowsky, German Ophthalmologist and former Professor of Ophthalmology at the University of Breslau, has joined the staff of the Department of Research in Physiologic Optics at Dartmouth. Dr. Beilschowsky will associate himself with Dr. Albert Ames, Jr., head of the department and the following research workers, Dr. Gordon H. Gliddon, Dr. Kenneth N. Ogle, Dr. Leo F. Madigan, Dr. Henry A. Imus and Dr. Elmer H. Carleton. All of these men have been working in the field of aniseikonia and Dr. Beilschowsky plans to assist in these researches, particularly as they relate to squint.

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ABSTRACTS

ALLERGY AND CATARACTS. Ruby K. Daniel. Journal of the American Medical Association. Vol. 107, No. 7, pp. 481-83. 1935.

Daniel first defines the term allergy as a condition of unusual or exaggerated specific hypersensitivity to a substance which, under like conditions and in similar amounts, is harmless for the large majority of members of the same species. She also finds that from 1 to 5 per cent of all human beings are allergic in some way, their reaction occurring in the skin or in the conjunctiva or in the respiratory or gastro-intestinal tissues. She also points out that a conjunctival hypersensitivity is a frequent symptom in patients suffering from the allergic manifestation of asthma,

*November 8, 1935.

hay fever or vasomotor rhinitis and even in some cases of vernal catarrh.

She then quotes Wesseley who claims that keratitis in certain forms can be allergic and who also claims that episcleritis, scleritis and certain involvements of the uveal tract can be traced to this same source. This being true it seems logical to assume that the crystalline lens itself is not wholly exempt from the influence of allergens. To more fully explain this statement she goes on to explain that the ectodermal epithelium of the ciliary body is responsible for the formation of the aqueous fluid, which in turn nourishes the crystalline lens and carries away its waste products. Now a fine change in the function of these epitherial cells of the ciliary body or in the content of the aqueous fluid or in the level of permeability and selectivities of the capsule of the lens can readily be reasoned to interfere with the efficient and normal metabolism of the lens and its transparency, thereby producing a cataract in what otherwise would be a normal eye.

Daniel then refers to some five or six previously reported cases in medical literature in which bilateral cataracts occurred following various alergic skin eruptions. She then presents three cases of her own which were observed at the Mayo Clinic. In these cases, as in those reported, all patients were young people and all suffered from allergic conditions such as hay fever, asthma, eczema and neurodermatitis. In all cases the crystalline lens of both eyes were affected, the appearance of the lens being similar to that of a patient suffering from anterior stellate cataract.

C. C. K.

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TONOMETRY. Otis Wolfe. Journal of the American Optometric Association. Vol. 6, No. 9, pp. 6-7. 1935.

Wolfe suggests making three tonometer readings in every case of suspected glaucoma. These readings should all be made on the same day and at one and one-half hour intervals. Also between the first and second reading the patient should be placed in a dark room. In a normal case, Wolfe claims, the first and third reading will be the same with the second reading showing an increase of from four to six millimeters in the intra-ocular pressure. In the glaucomatous case the third reading will be several millimeters higher than the first, irrespective of the reading shown on the first test. Cases showing this syndrome have according to Wolfe a predisposition to glaucoma.

C. C. K.

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A POINT IN THE DIFFERENTIATION BETWEEN CONGENITAL AMBLYOPIA AND AMBLYOPIA EX ANOPSIA. L. A. Swann. Optometric Weekly. Vol. 26, No. 23, p. 651. 1935.

Swann finds in working on amblyopic patients that the dynamic skiametric test is an aid in making a diagnosis between congenital ambly-

opia and amblyopia ex anopsia. He reports that the dynamic lag of accommodation in cases of amblyopia ex anopsia will be, as a rule, around plus 2.50 D, whereas in congenital amblyopia the dynamic lag will be much less, usually about the amount found in a normal functioning eye.

C. C. K.

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FATIGUE OF THE EXTRINSIC OCULAR MUSCLES WHILE READING UNDER SODIUM AND TUNGSTEN LIGHT. M. Luckiesh and Frank K. Moss. Journal of the Optical Society of America. Vol. 25, No. 7, pp. 216-217. 1935.

Vision, say these authors, may be defined simply as a tool for seeing and seeing as a result of a human being using this tool. The problem they set out to solve was simply this, whether the convergence fatigue engendered by an hour's "seeing" (in this case reading) under tungsten lamps would be more or less than that engendered by a similar effort under sodium-vapor lamps, both with the same illumination intensity.

The experiment was carried on as follows: A convergence ophthalmic ergograph was designed by the authors for measuring relative fatigue of the extrinsic ocular muscles. The internal recti muscles were caused to contract (adduction) by increasing the strength of a base-out prism placed in the line of vision of one eye. The strength of the internal extraocular muscles involved was determined by the amount of base-out prism which could be counteracted in maintaining single binocular vision. This prismatic duction test was repeated 20 times before and after each reading experiment with each individual finding recorded. Averages were then made and the difference between the ductions taken before and the ductions taken at the end of each reading experiment indicated the amount of convergence fatigue engendered under the various illuminants.

Five subjects were used in this test and the average results indicated that under the tungsten lamps the adduction fell-off 6 prism diopters while under the sodium vapor lamps it fell-off 8.4 prism diopters.

C. C. K.

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DEPTH PERCEPTION AND INTERPUPILLARY DISTANCE AS FACTORS IN PROFICIENCY IN BALL GAMES. Brant Clark and Neil Warren. American Journal of Psychology. Vol. XLVII, No. 7, pp. 485-487. 1935.

Clark and Warren investigate the matter of depth perception and its relation to athletic ability. This also led them into the field of interpupillary distance as it related to depth perception. Some 600 subjects were used in the experiment, some good in athletics and others showing no interest in athletics. The authors come to the following conclusions:

(1) that there is no significant relation between depth perception and interpupillary distance, i.e., those subjects having a wide interpupillary distance having better depth perception than those having a narrow interpupillary distance; (2) that the interpupillary distance of athletes does not differ from that of an unselected group; (3) that the depth perception of athletes does not differ from that of an unselected group.

C. C. K.

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ORTHOPTIC TREATMENT OF SQUINT. A. M. Hicks and G. N. Hosford. Archives of Ophthalmology. June, 1935.

Thirty-six cases of manifest squint were given orthoptic treatments by the authors after first correcting their existing ametropia by means of glasses. These patients ranged in age from 3 to 13 years. The treatments were given for periods varying from two to nine months. The instruments used in giving the orthoptic treatments were the Keystone stereoscope, the stereo-orthopter, the Worth-Black amblyoscope, the Wells stereo-optometer and the cheiroscope.

Hicks and Hosford reach the following conclusions as the result of treating these squint cases: (1) Orthoptic treatments are of value in developing fusion, but have a limited value in correcting squint. (2) Orthoptic treatments will not correct anatomic abnormalities which are frequently contributory causes in many squint cases. (3) It is of little value to develop or to attempt to develop binocular vision in squint cases unless the visual acuity of each eye is nearly equal. (4) It is probably of no value to attempt to develop binocular vision in the presence of aniseikonia. (5) In squint cases, if the necessary steps are taken to correct any existing amblyopia ex anopsia in the squinting eye, and if treatments are given to break down suppression and also to correct false projection as well as glasses to correct whatever refractive errors are present still the number of cases that will benefit from orthoptic treatment is small.

C. C. K.

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MUSCLE IMBALANCE IN MYOPIA. F. W. Marlow. Archives of Ophthalmology. April, 1935.

Marlow reports a study in myopia in which, (1) the prevalence of imbalances of the extrinsic ocular muscles was brought out and (2) that because nearly all cases of axial myopia, observed in this study, were also troubled with imbalances of these muscles, he comes to the conclusion that perhaps these muscular imbalances were in some manner a factor in the onset and development of the condition.

In two fairly large groups of myopic cases, Marlow fails to find one single case of what might be diagnosed, simple axial myopia, which

was free from either astigmatism or anisometropia in at least a small degree, or from some type of muscular imbalance, and the deduction he draws from this is that the pressure, in young people, exerted constantly upon the then abnormally plastic sclera by tense extrinsic muscles, in the interest of fusion for various distances, may supply an explanation for the causation and progression of myopia. C. C. K.

* * * * *

FACTORS IN THE PRODUCTION OF SQUINT. Edward Jackson. The American Journal of Ophthalmology. March, 1935.

Jackson finds that most strabismus cases start about the time children begin using their eyes to a considerable degree at the near-point. His reasoning as to the aetiology of this condition is, that the demand for continued near-point fixation taxes the newly acquired power of accommodation-convergence relationship thus producing eye-strain and upsetting the visual co-ordination that had previously served all of the child's visual purposes. In a case of this kind the excessive convergence which is brought into play along with excessive accommodation to overcome existing hyperopia, causes convergent squint.

Concomitant squints, particularly those showing a vertical imbalance start, he claims, as a rule because of some temporary paresis of one of the extra-ocular muscles. These cases can be corrected but the work must be done before the habit for binocular fixation is lost or the squint will probably become permanent.

As to the aetiology of divergent squint he reasons that in a myopic case the accommodational impulses no longer assist and stimulate to the necessary degree the corresponding convergence impulses. Now if the myopia increases in one eye more than another thereby making vision more difficult in one than in the other, and if the patient is called upon to do more near-point work than the convergence innervational impulses can stand the weaker eye will turn out and the case becomes one of divergent squint. At first this happens only occasionally, but in time the defect becomes constant. C. C. K.

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OPTOMETRISTS AND THE PUBLIC, A FEW POINTS ON. W. S. Walters. The Optician. Vol. LC, No. 2334, p. 324. 1935.

Walters, in discussing some economic optometric problems, brings out the following point, that the success of optometry as a profession lies not with the medical profession's opinion of optometrists; nor with the optometrists' opinion of themselves; but with the general public's opinion of us. He adds that fortunately the optometric profession has a long and healthy past and its future to a great extent depends entirely

on the conduct of individual optometrists as to whether the public's opinion of us is enhanced or lowered. Viewed in this light it is obvious that in some quarters some spring-house-cleaning is in order. Walters closes by suggesting that all refraction fees be entirely separated from whatever charges there may be for material. C. C. K.

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THE MANAGEMENT OF A CASE OF CONVERGENT STRABISMUS. M. Dobson. The American Journal of Ophthalmology. March, 1935.

Dobson refers to two orthoptic treatment instruments in this paper. These are the synoptiscope and the myoscope. In a case of convergent strabismus in which the squinting eye is also effected by amblyopia ex anopsia Dobson suggests the following routine or sequence of treatment procedure: (1) retinal stimulation of the amblyopic eye; (2) Suppression of the fixing eye; (3) When the visual acuity of the amblyopic eye is 20/200 or better, start stimulating binocular fixation with the synoptiscope; (4) Increase the restricted monocular field of fixation in the squinting eye and strengthen concomitant movements of the eyes, by means of the myoscope; (5) Develop fusion by first producing diplopia and then stimulating fusional desires by various stereoscopic training measures. C. C. K.

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SPECTACLES FOR THOSE FORCED TO BE RECUMBENT. Journal of the American Medical Association. Vol. 106, No. 1, p. 71. 1936. (Ill.)

This short article describes a pair of spectacles made with especially designed prisms which allow the wearer's eyes to be held in a normal position while recumbent, and at the same time enables the wearer to view the type page on a book held in a comfortable position, resting on the patient's chest or abdomen. The glasses are designed for hospital use for those patients who must stay for various periods in a recumbent position, and who wish to read without the fatigue engendered by holding the book above their heads. The prisms are designed so that light is reflected twice and emerges at the third surface free from distortion or color fringes. The frames for these prismatic-spectacles are so made that the outfit can be worn over the patient's regular correction. C. C. K.

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